**STABILITY ALGORITHMS FOR NEWTON RAPHSON METHOD OF LOAD FLOW ANALYSIS**

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**Abstract:**

Power-flow studies are of great importance in planning and designing the future expansion of power systems as well as in determining the best operation of existing systems. The principal information obtained from a power-flow study is the magnitude and phase angle of the voltage at each bus and the real and reactive power flowing in each line. However, much additional information of value is provided by the printout of the solution from computer programs used by the electric utility companies. Most of these features are made evident in our discussion of power-flow studies in this chapter. We shall examine some of the methods upon which solutions to the power-flow problem arc based .The value of the power-flow computer program in power system design and operation will become apparent.

**1. INTRODUCTION**

Load flow studies are help to ensure that electrical power transfer from generator to consumer through the grid system is stable, reliable & economic. The characteristics & performance of transmission line can vary over wide limits mainly dependent on their systems. There are different methods used in load flow studies such as: Gauss-Seidel, Newton-Raphson & Fast-Decoupled method. Out of this three methods NR method is used to maintain an acceptable voltage profile at various buses with varying power flow.

The power flow analysis is an importance tool involving numerical analysis applied to a power system. Unlike traditional circuit analysis, a power flow studies usually uses simplified notations such as a one-line diagram & per-unit system & focuses on various form of AC power ie. reactive, real & apparent rather than voltage & current.

**2. POWER FLOW OVER VIEW**

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The overall aim of the whole paper is to develop a program that allow user to solve power flow problem. However the other objective that needed to complete are:

1. Power flow analysis is very important in planning stages of new networks or addition to existing ones like adding new generator sites, meeting increase load demand and locating new transmission sites.

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2. The load flow solution gives the nodal voltages and phase angles and hence the power injection at all the buses and power flows through interconnecting power channels.

3. It determines the voltage of the buses. The voltage level at the certain buses must be kept within the closed tolerances.

4. The line flows can be known. The line should not be overloaded, it means, we should not operate the close to their stability or thermal limits.

5. To study the performance of the transmission lines, transformer and generator at steady state condition.

6. To write a program for power flow analysis for education and training purposes

**3. LOAD FLOW SOLUTION**

In Power System Engineering, the load flow study (also known as power flow study) is an important tool involving numerical analysis applied to a power system. Unlike traditional circuit analysis , a power flow study uses simplified notation such as a one line diagram and per unit system , and focuses on various forms of AC power (i.e. reactive ,real and apparent ) rather than voltage and current. It analyses the power systems in normal steady state operation. There exist a number of software implementations of power flow studies.

 **4. STABILITY CONCEPT**

 The importance of power system stability is increasingly becoming one of the most limiting factors for system performance. By the stability of a power system, we actually mean the ability of the system to remain in operating equilibrium, or synchronism, while disturbances occur on the system. There are three types of stability, namely, steady-state, dynamic and transient stability.

 Stability Definitions In the study of electric power systems, several different types of stability descriptions are encountered. There are three types of stability namely,

**(1) Steady-state stability** –It refers to the stability of a power system subject to small and gradual changes in load, and the system remains stable with conventional excitation and governor controls.

**(2) Dynamic stability** –It refers to the stability of a power system subject to a relatively small and sudden disturbance, the system can be described by linear differential equations, and the system can be stabilized by a linear and continuous supplementary stability control.

**(3) Transient stability** –It refers to the stability of a power system subject to a sudden and severe disturbance beyond the capability of the linear and continuous supplementary stability control, and the system may lose its stability at the first swing unless a more effective countermeasure is taken, usually of the discrete type, such as dynamic resistance braking or fast valving for the electric energy surplus area, or load shedding for the electric energy deficient area. For transient stability analysis and control design, the power system must be described by nonlinear differential equations. Transient stability concerns with the matter of maintaining synchronism among all generators when the power system is suddenly subjected to severe disturbances such as faults or circuits caused by lightning strikes, the sudden removal from the transmission system of a generator and or a line, and any severe shock to the system due to a switching operation

**5. NEWTON RAPHSON METHOD ALGORITHM**

The Newton-Raphson method is widely used for solving non-linear equations. It transforms the original non-linear problem into a sequence of linear problems whose solutions approach the solutions of the original problem. Let G=F(x,y) be an equation where the variables x and y are the function of arguments of F. G is a specified quantity. If F is non-linear in nature there may not be a direct solution to get the values of x and y for a particular value of G. in such cases, we take an initial estimate of x and y and iteratively solve for the real values of x and y until the difference is the specified value of G and the calculated value of F(using the estimates of x and y) i.e. ΔF is less than a tolerance value. The procedure is as follows Let the initial estimate of x and y be x0 and y0 respectively Using Taylor series [3]

 **G=F(X0,Y0)+││x0y0∆x+.x0y0**

**Where and are calculated at x0 and y0**

**G-F(x0,y0)=∆F=.∆x+.**

**In the matrix form it can be written as**

**∆x**

( )

**(∆F)=(**

After the first iteration x is updated to x1 = x0 + Δx and y to y1 = y0 + Δy. The procedure is continued till after some iteration both ΔF is less than some tolerance value ε. The values of x and y after the final update at the last iteration is considered as the solution of the function F. For the load flow solution , the non-linear equations are given by equation . There will be 2n – 2 – p such equations, with n being the total number of buses and p the number of PV and generator buses**.**

( )=( )( )

nkjnjbjbjb

**∆δ**

**∆p**

**∆│V│**

**∆Q**

The matrix of equation (consisting of the partial differentials, is known as the Jacobian matrix and is very often denoted as J.ΔP is the difference between the specifies value of P(Psp) and the calculated value of P using the estimates of δ and |V| in a previous iteration. We calculate ΔQ similarly. The Newton power flow is the most robust power flow algorithm used in practice. However, one drawback to its use is the fact that the terms in the Jacobian matrix must be recalculated each iteration, and then the entire set of linear equations in equation must also be resolved each iteration. Since thousands of complete power flow are often run for planning or operations study, ways to speed up this process were devised [1].

Power flow or load-flow studies are important for planning future expansion of power systems as well as in determining the best operation of existing systems. The principal information obtained from the power flow study is the magnitude and phase angle of the voltage at each bus, and the real and reactive power flowing in each line. We have formulated the algorithm and designed the MATLAB programs for bus admittance matrix, converting polar form to rectangular form, Gauss-Siedel method and Newton Raphson method for analyzing the load flow of the IEEE- bus systems. The Voltage magnitude and angles of a bus system were observed for different values of Reactance loading and the findings have been presented. From the findings, it is concluded that increasing the reactance loading resulted in an increased voltage regulation. Gauss-Siedel has simple calculations and is easy to execute, but as the number of buses increase, number of iterations increases. On the other hand, in Newton-Raphson. method, is the calculations are complex, but the number of iterations is low even when the number of buses high.[5]

**6 .CONCLUSION**

**7. REFFERENCES**

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**8.Implementation**

No

Fig 2. N-R method implementation flow diagram[6].

Update the voltage magnitude and angle with the mismatch calculated

Solve for the voltage magnitude and angle mismatch

End

Calculate the new Jacobian matrix of the method using the new voltage magnitude and angle from the previous iteration.

Solution is met

Yes

Does power mismatch fall in range of the tolerance?

Calculate power mismatch, and .

Form the admittance matrix

Make initial estimation for all unknown voltage magnitude and angle

Identifying all bus type